CLAIMS

1. A nucleotide vaccine composition comprising:
   - nucleotide sequence encoding an antigen; and
   - antigen-presenting cells modified for expression of an immune response modulating molecule.

2. A nucleotide vaccine composition comprising:
   - nucleotide sequence encoding an antigen; and
   - antigen-presenting cells modified for expression of a cell-survival modulating molecule.

3. The vaccine composition according to claim 2, wherein in said cell-survival modulating molecule is an apoptosis-inducing molecule.

4. The vaccine composition according to any of the claims 1 to 3, wherein said vaccine composition is provided as a mixture of said nucleotide sequence and said modified antigen-presenting cells.

5. The vaccine composition according to claim 4, wherein said vaccine composition is provided as a pre-incubated mixture of said nucleotide sequence and said modified antigen-presenting cells.

6. The vaccine composition according to any of the claims 1 or 5, wherein said antigen-presenting cells are professional antigen-presenting cells.

7. The vaccine composition according to claim, wherein said professional antigen-presenting cells are dendritic cells.

8. The vaccine composition according to claim 7, wherein said dendritic cells are efficient antigen-processing and antigen-presenting cells.

9. The vaccine composition according to claim 7 or 8, wherein said dendritic cells are plasmacytoid dendritic cells.

10. The vaccine composition according to any of the claims 1 to 9, wherein said antigen-presenting cells are human equivalents to a subclass of dendritic cells that express CD8α, B220, CD11C and B7 molecules in mice.

11. The vaccine composition according to any of the claims 1 to 10, wherein said antigen-presenting cells express Toll-like receptor 9.

12. The vaccine composition according to any of the claims 1 to 11, wherein said antigen-presenting cells express P2X7.

13. The vaccine composition according to any of the claims 1 to 12, wherein said antigen-presenting cells can be induced to produce type I interferon-alpha and/or interferon-beta.

14. The vaccine composition according to claim 13, wherein said antigen-presenting cells produce said type I interferon-alpha and/or interferon-beta when interacting with microbes.

15. The vaccine composition according to any of the claims 1 to 14, wherein said antigen-presenting cells function as linkers between innate and adaptive immune response in a subject.

16. The vaccine composition according to any of the claims 1 to 5, wherein said antigen-presenting cells are selected from at least one of:

- dendritic cells;
- plasmocytoid dendritic cells;
- interferon-producing cells;
- natural-interferon producing cells;
- monocytes;
- macrophages;
- bone marrow derived cells;
- cells differentiated from stem cells
- B cells;

- T cells; and
- Mast cells.

17. The vaccine composition according to claim 1, wherein said immune response modulating molecule is encoded by a nucleotide sequence engineered into said antigen-presenting cells, said gene sequence is selected from at least one of:

- cytokine gene;
- Interleukin gene;
- adhesion molecule gene;
- interferon gene; and
- chemokine and chemokine receptor gene.

18. The vaccine composition according to claim 17, wherein said immune response modulating molecule is selected from CD40 ligand and GM-CSF.

19. The vaccine composition according to claim 2 or 3, wherein said cell-survival modulating molecule is encoded by a nucleotide sequence engineered into said antigen-presenting cells, said gene sequence is selected from at least one of:

- anti-apoptosis gene; and
- apoptosis inducing gene;

20. The vaccine composition according to any of the claims 1 to 19, wherein said nucleotide sequence is provided in a vector selected from at least one of:

- virus vector;
- non-viral vector;
- plasmid;
- microbe-derived vector
- liposome; and
- small molecule carrier.

21. The vaccine composition according to claim 20, wherein said vector comprises an immune response modulating nucleotide sequence.

22. The vaccine composition according to claim 21, wherein said immune response modulating nucleotide sequence is an unmethylated cytidine phosphate guanosine (CpG) sequence.

23. The vaccine composition according to any of the claims 1 to 22, wherein said antigen comprises the e1a2 fusion peptide defined as the amino acid sequence of SEQ ID NO: 5.

24. The vaccine composition according to any of the claims 1 to 22, wherein said nucleotide sequence comprising the nucleotide sequences of the mini-e1a2 fusion gene of SEQ ID NO: 3.

25. The vaccine composition according to any of the claims 1 to 22, wherein said nucleotide sequence comprises a nucleotide sequence encoding the mini-e1a2 fusion protein of SEQ ID NO: 4.

26. A method of producing a nucleotide and cellular vaccine composition comprising the steps of:

- providing nucleotide sequence encoding an antigen;
- providing antigen-presenting cells modified for expression of an immune response modulating molecule; and
- mixing said nucleotide sequence encoding said antigen and said modified antigen-presenting cells.

27. The method according to claim 26, further comprising the step of incubating said nucleotide sequence with said modified antigen-presenting cells for enhancing the binding.

28. The method according to claim 26 or 27, wherein said nucleotide sequence providing step comprises the steps of:

- providing a MHC-binding antigenic protein or peptide;
- cloning said nucleotide sequence encoding said antigenic protein or said antigenic peptide into a said vector; and
- propagating said vector in a propagation system.

29. The method according to any of the claims 26 to 28, wherein said antigen-presenting cells providing step comprises the steps of:

- isolating said antigen presenting cells from a subject; and
- engineering said antigen-presenting cells to express said immune response modulating molecule.

30. The method according to claim 29, wherein said isolating step comprises the step of isolating a subclass of dendritic cells that expresses Toll-like receptor 9 and has the ability to produce Interferon alpha and/or Interferon beta.

31. The method according to claim 30, wherein said subclass of dendritic cells plays an important role in innate and acquired immune response in a subject.

32. The method according to claim 30 or 31, wherein said subclass of dendritic cells is plasmocytoid dendritic cells.

33. A vaccine composition according to claim 1 or 2 for use as a medicament.

34. Use of a vaccine composition according to claim 1 or 2 for the manufacturing of a medicament for treating or preventing an infectious disease, wherein said nucleotide sequence encodes an antigen associated with an infectious agent involved in said disease.

35. Use of a vaccine composition according to claim 1 or 2 for the manufacturing of a medicament for treating or preventing cancer, wherein

said nucleotide sequence encodes a tumor-associated antigen expressed in cancers.

36. A method of producing an immune response comprising the step of administering the vaccine composition to a subject according to claim 1 or 2.

37. A method of treating or preventing a disease in a subject comprising the step of administering to said subject a vaccine composition according to claim 1 or 2, said antigen being associated with an agent involved in said disease.

38. The method according to claim 36 or 37, wherein said antigen presenting cells are adapted for presenting at least a fragment of said antigen to cells of the immune system of said subject.

39. The method according to any of the claims 36 to 38, wherein said subject is a mammalian subject.

40. The method according to claim 39, wherein said mammalian subject is a human subject.

41. The method according to claim 36, wherein said disease is selected from at least one of:

- infectious disease;
- cancer;
- leukemia;
- lymphoma;
- autoimmune disease/disorder;
- inflammation;
- blood disease;
- allergy;
- inherited disease;
- transplantation required disease; and

- diabetes.

42. A kit comprising:

- nucleotide sequence encoding an antigen; and
- antigen-presenting cells modified for expression of an immune response modulating molecule.

43. The kit according to claim 42, wherein said nucleotide sequence and said modified antigen-presenting cells are provided as a mixture.
